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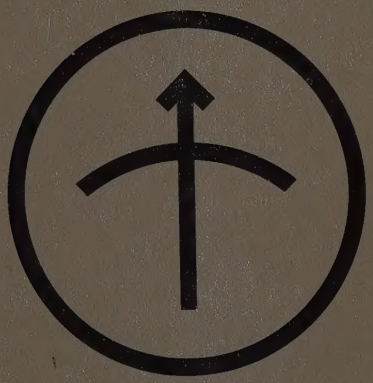
MODEL 140

MODEL 140
STANDARD DEVIATION METER

Operating INSTRUCTIONS



MEASUREMENTS

A McGRAW-EDISON DIVISION

BOONTON NEW JERSEY

MODEL 140
STANDARD DEVIATION METER

Operating INSTRUCTIONS

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A McGRAW-EDISON DIVISION
BOONTON NEW JERSEY

MODEL 140

STANDARD DEVIATION METER

- NOTE -

Instruments with the letter suffix G following the serial number, have an additional calibration point at .75 kilocycles on the meter scale.

Maximum power input should not exceed 0.5 watt into HIGH INPUT connector and 0.08 watt into LOW INPUT connector.

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Model 140
DEVIATION METER

INSTRUCTION BOOK

MODEL 140

STANDARD DEVIATION METER

CHAPTER I
INTRODUCTION
SECTION I
GENERAL

1. SCOPE OF MANUAL

a. This book describes the operation of the Model 140 Standard Deviation Meter for measuring peak deviation of FM transmitters. Instructions are also included for field maintenance of the instrument to assure optimum performance. A list of Replaceable Parts (Appendix I) follows the text.

2. DESCRIPTION

a. The Model 140 Standard Deviation Meter is a portable, self-contained instrument designed to accurately measure the peak frequency deviation of frequency modulated communications transmitters. It is particularly suited to mobile radio servicing.

This deviation meter contains an accurate, linear, counter-type discriminator and a heavily degenerative voltmeter similar to Measurements' industry proven Model 67 Peak-to-Peak Voltmeter

The highly stable conversion oscillator allows measurement at frequencies to 1000 megacycles with low inherent residual frequency modulation and maximum freedom from drift.

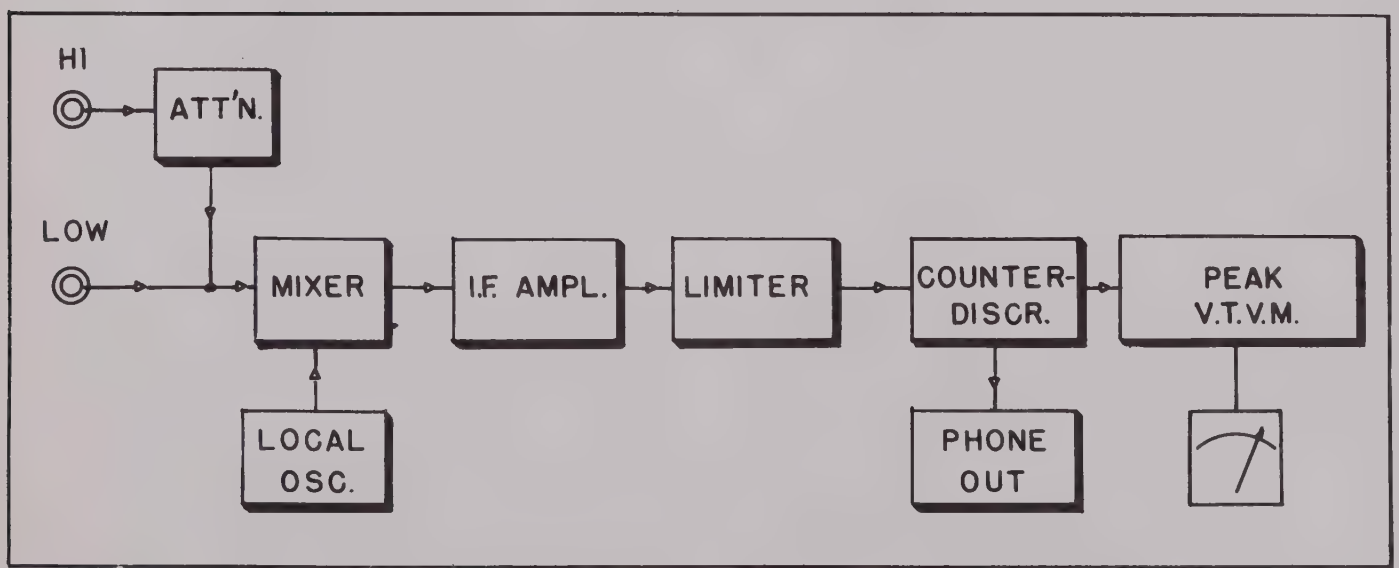
Provision is made for easy standardization without the need for an accurate frequency modulated source or resort to complicated Bessel-null techniques.

To extend the useful range of the instrument below 1 megacycle, an external oscillator may be used to heterodyne transmitter frequencies to the 100-kilocycle intermediate frequency.

The discriminator output, available from a front panel jack (PHONES), provides a convenient source for measurements of distortion and noise.

The output system includes a 750-microsecond de-emphasis network which allows the Model 140 to be used as a standard receiver meeting the requirements of EIA Standard RS-152-A.

Considerable care was exercised in the manufacture to provide low inherent noise and distortion compatible with the specification.



MODEL 140 BLOCK DIAGRAM

b. The Model 140 is designed for FM transmitter measurements at all communications frequencies to 1000 megacycles. This is a laboratory instrument which, due to its rugged construction, may be used equally well for mobile radio servicing in the field or on the production line.

3. SPECIFICATIONS

a. CARRIER FREQUENCY RANGE: 25 to 1000 megacycles per second. (25 to 50 mcs local oscillator provides useful harmonics to beyond 1000 megacycles per second.)

b. SENSITIVITY: 25 to 100 millivolts at frequencies to 500 megacycles; 100 to 1000 millivolts at frequencies to 1000 megacycles per second.

c. RESIDUAL FREQUENCY MODULATION: Less than 100 cps at 500 mcs.

d. INPUT IMPEDANCE: Nominally 50 ohms.

e. DEVIATION RANGES: 0 to 5 kcs, 0 to 20 kcs.

f. DEVIATION ACCURACY: ± 3% of full scale.

g. MODULATION FREQUENCY RESPONSE: Flat from 100 cps to 8 kcs.

h. INPUT GAIN CONTROL: 5 to 1 fixed (high and low input terminals) plus 5 to 1 variable (INPUT GAIN control) provide 25 to 1 over all attenuation.

i. PHONE OUTPUT: Cathode follower output with PHONE GAIN Control. (A 750 micro-second de-emphasis network is included in the PHONES jack output.) Linear output, direct from the discriminator, may be obtained from the CAL jack.

j. SIZE: 14" high x 10" wide x 7 1/4" deep without cover.

k. WEIGHT: 19 pounds (21 pounds with cover).

l. POWER SUPPLY: 115 volts, 50-60 cycles, 75 watts.

CHAPTER II

OPERATING INSTRUCTIONS

SECTION I

GENERAL

4. PRELIMINARY INSPECTION

a. Following unpacking, inspect the instrument visually for possible damage during shipment. If any damage is observed notify MEASUREMENTS immediately.

b. A detached power cord is furnished with each instrument. Check to make certain this is received.

5. OPERATING CONTROLS

a. INPUT GAIN: This control adjusts the gain of the signal applied to the metering circuits. The attenuation ratio is approximately 5 to 1. The INPUT connectors (HIGH and LOW) provide fixed attenuation of approximately 5:1. In general the LOW connector is used when the incoming signal is in the range of 25 to 100 millivolts while the HIGH connector is used with stronger signals. Overall attenuation of the fixed step and variable control is 25:1.

b. LOCAL OSC. TUNING: This dial controls the tuning of the local oscillator which operates between 25 and 50 mcs.

c. FINE TUNING: This knob permits extremely fine electronic adjustment of local oscillator frequency to facilitate tuning.

d. METER RANGE: This switch selects the meter function as described below:

(1) MIXER LEVEL: When in this position the strength of the incoming signal is indicated. The purpose of this check is to protect the mixer diode against damage due to application of a strong signal (greater than approximately 2 VAC) during preliminary antenna adjustments.

(2) TUNE: In this position the meter will peak when the local oscillator is adjusted to produce a 100 kcs beat with the incoming signal.

(3) 5 KC or 20 KC: These positions select the desired meter deviation range.

(4) DISCR. CAL.: This position is used only when checking the discriminator. Discriminator adjustment is desirable if tubes are replaced. The discriminator should be checked periodically to assure optimum performance.

e. PHONE GAIN: This knob adjusts the gain of the recovered modulation signal applied to the PHONES jack.

6. INSTALLATION

a. The Model 140 being portable test equipment requires no special mounting facilities. Caution should be observed however, to provide clearance for the ventilation holes in the bottom of the case. Blocking these holes will prevent the free passage of air and the instrument will overheat.

SECTION II

OPERATION

7. DEVIATION MEASUREMENTS

a. Connect the Model 140 to a 115-volt, 50/60 cps power source and allow about 10 minutes for the circuits to stabilize.

b. Place METER RANGE switch in MIXER LEVEL position and adjust input from transmitter to keep meter pointer on scale. Note that the HIGH and LOW input connectors provide a fixed attenuation of 5:1. Always connect to the HIGH connector when making preliminary adjustments. Use the LOW connector only after it is known that the input signal is insufficient to produce a satisfactory meter reading through the HIGH input. It should be noted that

signal indications beyond 1/4 scale will normally provide much more signal than is required for operation of the instrument. Additional attenuation of the input signal by the use of external attenuator or reduced antenna coupling will normally be required if the meter reads beyond quarter scale.

c. Place METER RANGE switch in TUNE position and rotate the LOCAL OSC. TUNING to obtain a peak meter reading. This will be obtained whenever the local oscillator (fundamental or harmonic frequency) is exactly 100 kcs away from the input frequency. When the transmitter frequency is between 25 and 50 mcs, the fundamental frequency of the local oscillator is used. When the transmitter is above 50 mcs, harmonics of the local oscillator will produce the desired 100 kcs difference frequency. The following chart lists dial readings that may be used at various mobile transmitter frequencies.

Mobile Transmitter Frequency (mcs)	Model 140 Dial (± 100 kcs)	Harmonic
25 to 50	25 to 50	Fundamental
50 " 54	25 " 27	2nd
129 " 141	43 " 47	3rd
141 " 150	47 " 50	3rd
150 " 160	37.5" 40	4th
160 " 174	40 " 43.5	4th
396 " 432	44 " 48	9th
432 " 450	48 " 50	9th
450 " 470	45 " 47	10th
874 " 912	46 " 48	19th
912 " 950	48 " 50	19th
950 " 960	47.5" 48	20th

Adjust INPUT GAIN to bring meter pointer within green area of the scale. If necessary, reduce coupling to the transmitter under test, or use an external attenuator to allow peaking in the green area.

Approximate voltages required to obtain a peak reading are indicated in figure 1.

Above 500 mcs satisfactory operation is obtained with a peak deflection of only one fourth full scale.

Note that the mixer will saturate at frequencies above 750 megacycles (figure 1). It is desirable, to maintain the level of the signal applied to the mixer below the indicated saturation level. An increase beyond saturation will normally decrease the level of the meter reading. Use the internal 5:1 attenuator (high input position), reduce coupling to transmitter, or use an external attenuator. The saturation effect will not be noticeable below approximately 750 megacycles because the saturation occurs beyond full-scale reading.

NOTE

When using harmonics of the local oscillator, always use the highest frequency setting of the dial (lowest harmonic) for maximum sensitivity.

d. Place METER RANGE switch in either 20 KC or 5 KC position and read deviation directly on meter scale. If the local oscillator frequency is below the signal frequency, the meter will indicate deviation on the high side of carrier, when the (+) (-) switch is in (+) position. (Peak deviation is equal to one half the sum of the (+) and (-) deviation readings.) Unequal positive and negative readings indicate modulation asymmetry. Refer to

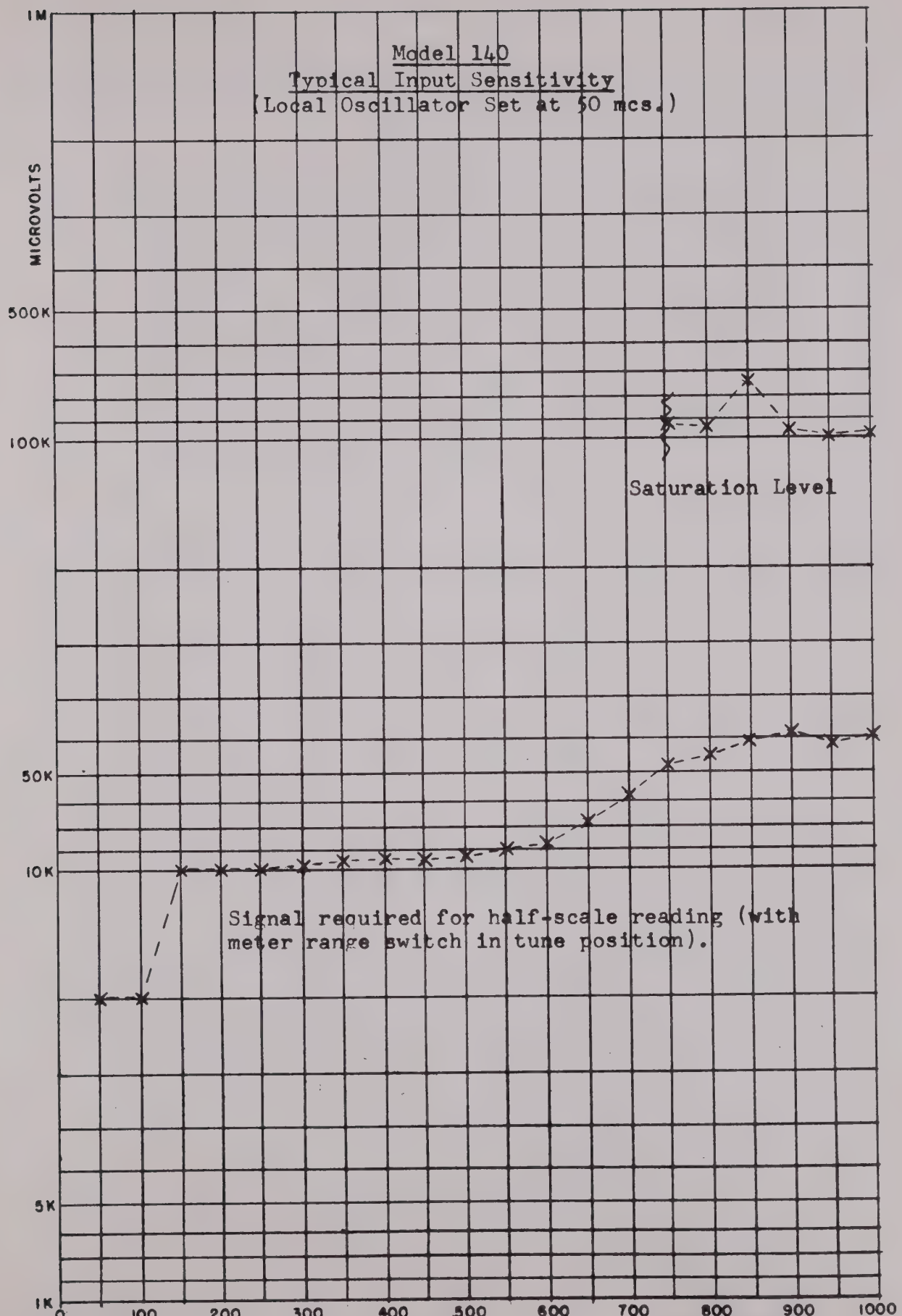

Model 140
Typical Input Sensitivity
(Local Oscillator Set at 50 mcs.)
MICROVOLTS
1M
500K
100K
50K
10K
5K
1K
Saturation Level
Signal required for half-scale reading (with meter range switch in tune position).
0
100
200
300
400
500
600
700
800
900
1000
MEGACYCLES / SEC.

Figure 1

paragraph 8 for the procedure to follow for measuring distortion.

NOTE

The Model 140 Deviation Meter is an extremely precise FM receiver and, like a receiver, must be quieted by tuning to an incoming signal to prevent noise from being generated in the output.

If the Model 140 is detuned while the METER RANGE switch is in either the 20 KC or 5 KC positions, the meter may peg or bounce erratically and the output from the phone jack will by noisy. THIS IS NOT AN INDICATION OF FAULTY OPERATION. The meter is protected from damaging overvoltage by the circuitry and will return to the normal quieted position when the input signal is restored and the local oscillator is retuned.

8. DISTORTION MEASUREMENTS

a. Tune the Model 140 to the transmitter signal as described in paragraph 7, OPERATION, then connect a suitable distortion meter to the PHONES jack.

b. Inherent distortion in the Model 140 is normally less than one per cent below the 10 kcs deviation level.

9. NOISE MEASUREMENTS

a. Residual carrier noise may be measured by connecting a high impedance a-f meter to the PHONES jack. The inherent noise of the Model 140 is approximately -45 db, at 150 mcs, standardized at 10 kcs deviation, 1 KC modulation frequency. A 750-microsecond de-emphasis network allows the Model 140 to be used as a standard receiver meeting the requirements of EIA Standard RS-152-A.

CHAPTER III

MAINTENANCE INSTRUCTIONS

SECTION I

FIELD MAINTENANCE

10. PRELIMINARY PROCEDURE

a. This section describes maintenance procedures that should be followed periodically to correct minor errors resulting from tube aging or replacement. The instrument should be operated one hour prior to making any readjustments; this will assure optimum accuracy.

11. METER ZERO

a. With power disconnected, check mechanical zero of meter. Apply power and, using a pin-tip probe, short-circuit CAL VOLTS pin jack to grounded pin jack. Place METER RANGE switch in the 20 kcs position. Remove guard from METER ZERO control and adjust meter for zero reading. Replace guard and remove short from CAL VOLTS jack.

12. METER CALIBRATION

METHOD A. - USING FM SIGNAL: Connect a frequency-modulated signal to the INPUT connector and tune the Model 140 for normal readout as described under OPERATION, paragraph 7. Connect a meter capable of reading 1 volt, peak-to-peak, to the CAL VOLTS pin jack. Place METER RANGE switch in 5 kcs position and increase modulation until the meter connected to CAL VOLTS reads exactly 1 volt, peak-to-peak. If the modulation is symmetrical, the meter should now read exactly full scale (5 kcs) with the (+), (-) switch in either position. When modulation is not symmetrical the average deviation (one half the sum of the (+) and (-) readings) will be 5 kcs and the meter reading

should be re-adjusted accordingly. For example, let us assume that the positive reading shows 5 kcs deviation and the negative reading indicates only 4.8 kcs. Since the peak-to-peak voltage at the CAL VOLTS pin jack is exactly one volt the average deviation is 5 kcs. The METER ADJ control should therefore be reset to produce a meter reading of 5.1 kcs deviation for (+) measurements and 4.9 kcs deviation for (-) measurements.

NOTE

> Unequal positive and negative readings are an indication of distortion originating in the transmitter modulator. Only under unusual conditions will unequal readings be the result of a malfunction of the Model 140 and it can be quickly checked by tuning the LOCAL oscillator to the opposite side of the carrier ("image" frequency). If the distortion is on the incoming signal, the (+) and (-) readings will be reversed.

The 20 kc scale may be checked by placing the METER RANGE switch in 20 KC position and increasing modulation to produce a 4-volt peak-to-peak reading at the CAL VOLTS jack. If previously adjusted using the 5 kcs reference, the meter should now read 20 kcs ± 1%.

METHOD B. - USING AF SIGNAL: Apply an unmodulated r-f signal to the input of the Model 140 and follow the tuning procedure described under OPERATION. This will quiet the receiver portion of the instrument and prevent extraneous readings. Using an external audio frequency oscillator, apply a 1-volt, peak-to-peak signal to the CAL VOLTS pin jack. (The output impedance of the audio frequency oscillator should be less than 1000 ohms). The audio frequency should be within the range of 120 to 7500 cps. Place METER RANGE switch in 5 KC position; the meter should now read 5 kc, for both positive and negative positions of the (+), (-) switch. When modulation is not symmetrical the average deviation (one half the sum of the (+) and (-) readings) will be 5 kc, and the meter reading should be re-

adjusted accordingly. For example, let us assume that the positive reading shows 5 kcs deviation and the negative reading indicates only 4.8 kcs. Since the peak-to-peak voltage at the CAL VOLTS pin jack is exactly one volt the average deviation is 5 kcs. The METER ADJ. control should therefore be reset to produce a meter reading of 5.1 kcs deviation for (+) measurements and 4.9 kcs deviation for (-) measurements.

The 20 KC scale may be checked by increasing the magnitude of the audio signal to 4 volts, peak-to-peak. If previously adjusted using the 5 kcs reference, the meter should now read 20 kcs ± 1%.

13. DISCRIMINATOR ADJUSTMENT

a. Connect a signal of 100 kcs ± 1% to the INPUT and, with METER RANGE switch in TUNE position, adjust signal strength to bring meter pointer to green area of scale. Rotate switch to DISCR. CAL. position and meter pointer should rest at the red dot, located about 3/4 inch from full scale calibration. If necessary, remove guard from DISCR. ADJ. control and set meter to red dot. Replace guard.

SECTION II

INTERNAL ADJUSTMENTS

14. PRELIMINARY INSTRUCTIONS

a. In the event trouble is encountered during the warranty period of the instrument it should be returned to MEASUREMENTS for repair. Removal of the instrument from its case requires breaking the instrument's seal which will void the warranty.

b. Before attempting any readjustments the user should be thoroughly familiar with the function of the various circuits and have proper test equipment available. Instruments required to make all adjustments necessary are listed below.

Oscilloscope with at least 5 mcs bandwidth.

Audio Oscillator, 100 to 100,000 with good wave form.

Model 162 Voltmeter (or equivalent)
with flat response from 100 to 10,000 cps.

15. REMOVAL FROM CASE

a. The Model 140 may be removed from its case by unscrewing three #10 filister head screws located at each side and the top of the front panel, the four #6 screws in the base of the case, and two #6 screws in the rear of the case.

CAUTION

One of the four screws in the base is sealed. If this seal is broken the instrument warranty is void.

16. HTR. ADJ.

a. This control, located along the lower edge of the right-side chassis, permits adjustment of the d-c heater voltage of the oscillator tube V3.

b. Connect a d-c voltmeter to the positive terminal of C2 (located adjacent to power transformer on inner surface of right-side chassis).

c. Apply nominal line voltage (115 volts, 50/60 cps) and set HTR. ADJ. control for a reading of + 6.3 volts.

17. + 200 ADJ.

a. This control, located on the left side chassis, permits adjustment of the positive plate potential.

b. Connect an accurate d-c voltmeter capable of reading + 200 volts between the common connection of the resistors R11 and R12 and ground. Adjust + 200 ADJ. control for exactly 200 volts.

CAUTION

After readjustment of +200 ADJ. it will normally be necessary to make slight readjustments of DISC CAL., CAL VOLTS and MULTI ADJ. see paragraphs 12, 13 and 19.

18. FILTER TERM.

a. This control, located on the filter assembly bracket mounted on the right side chassis permits adjustment of the filter termination to provide the proper filter response.

b. Disconnect capacitor C55 from the junction of CR17 and CR18. Care must be observed to avoid overheating the diodes when unsoldering this connection.

c. Connect an audio frequency generator through a 1 K ohm resistor to capacitor C55. Connect a vacuum tube voltmeter across the generator terminals; this voltmeter must have a flat frequency characteristic between 100 and 35000 cps. Set METER RANGE switch at 20 KC. Adjust input voltage at 500 cps to produce full scale reading on the Model 140 panel meter.

d. Maintaining constant input voltage, check meter reading on Model 140 panel for identical readings at 500 and 6000 cps. Reset FILTER TERM. control (R98) if necessary to obtain this condition. Do not disturb setting for following tests.

e. Maintain a constant input voltage and check filter characteristic between 100 and 32000 cps for compliance with the following table:

Reference 500 cps	0 DB
100 to 8000 cps	± 1%
approx. 32000 cps	- 6 DB

f. Resolder C55 to junction of CR17 and CR18.

19. MULTI. ADJ.

a. Apply a 100 kcs signal to the input connector and, with METER RANGE switch in TUNE position, tune for a peak meter reading in center of green area of scale.

b. Connect an oscilloscope (minimum bandwidth of 5 mcs) to pin 6 of tube V8. The pattern should be similar to that shown in figure 2. If this pattern is not obtained follow the procedure outlined in the following paragraphs, c and d.

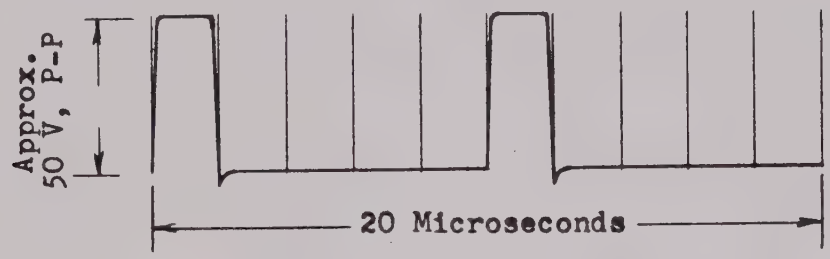


Figure 2. Multivibrator Test Pattern

c. Rotate DISCR. ADJ. control to full counter clockwise position, then set MULTI. ADJ. control, located on upper edge of right-side chassis, to obtain the widest and most stable pulse, (see figure 2).

d. Place METER RANGE switch in DISCR. ADJ. position apply 100 kc ± 1% to the input connector and re-adjust DISCR. ADJ. control to bring meter pointer to the red dot which is located about 3/4 inch from full scale.

APPENDIX I

TABLE OF REPLACEABLE PARTS

Model 140 Standard Deviation Meter

Symbol	Part No.	Description
C1	H-6688-5	Electrolytic; 20-40 mf, 450 V.
2	H-5354	" 1000 mf, 12 V.
3	H-6618	Paper; .25 mf, ± 20%, 400 V.
4	H-6619-4	Ceramic; 10 K mmf, GMV.
5	H-5515	Feedthru; 1 K mmf, GMV.
6	H-6610	Electrolytic; 40 mf, 450 V.
7	H-6610	" " "
8	H-5515	Feedthru; 1 K mmf, GMV.
9	H-6671-2	Ceramic; 10 mmf NPO, ± 10%.
10	H-6990	Variable; Air Dielectric, 2 Sections.
11	H-6613	Ceramic; 2.2 mmf, ± .5 mmf.
12	H-5515	Feedthru; 1 K mmf, GMV.
13	H-5515	" " " "
14	H-6619-4	Ceramic; 10 K mmf, GMV.
15	H-6688-1	Electrolytic; 8 mf, 450 V.
16	H-6671-24	Ceramic; 100 mmf, ± 10%.
17	H-6671-1	Ceramic; 5 mmf NPO, ± 10%.
18	H-6647	Ceramic; 1 K mmf, GMV.
19	H-6647	" 1 K mmf, GMV.
20	H-6688-3	Electrolytic; 10-10-10 mf, 450 V.
21	H-6671-7	Ceramic; 47 mmf NPO, ± 10%.
22	H-5589	Paper; .1 mf, ± 20%, 400 V.
23	H-5064	Ceramic; 5 K mmf, GMV.
24	H-6619-4	" 10 K mmf, GMV.
25	H-6647	" 1 K mmf, GMV.

Model 140 Standard Deviation Meter

Symbol	Part No.	Description
C26	H-6671-7	Ceramic; 47 mmf NPO, ± 10%.
27		
28	H-6306	Ceramic; 20 K mmf, GMV.
29	H-6671-9	Mica; 68 mmf, ± 10%.
30	H-5589	Paper; .1 mf, ± 20%, 400 V.
31	H-5589	Paper; .1 mf, ± 20%, 400 V.
32	H-6671-7	Ceramic; 47 mmf NPO, ± 10%.
33	H-6688-2	Electrolytic; 10-10 mf, 450 V.
34		
35	H-6619-4	Ceramic; 10 K mmf, GMV.
36	H-6647	Ceramic; 1 K mmf, GMV.
37	H-6619-4	Ceramic; 10 K mmf, GMV.
38	H-6671-16	Mica; 470 mmf, ± 10%.
39	H-6619-4	Ceramic; 10 K mmf, GMV.
40	H-6671-7	Ceramic; 47 mmf NPO, ± 10%.
41	H-6619-4	Ceramic; 10 K mmf, GMV.
42	H-6619-4	" " " "
43		
44		
45	H-6619-4	Ceramic; 10 K mmf, GMV.
46	H-6334	Ceramic; 15 mmf, N750.
47	H-6671-6	Ceramic; 33 mmf NPO, ± 5%.
48	H-6671-3	Ceramic; 15 mmf NPO, ± 10%.
49	H-6619-4	Ceramic; 10 K mmf, GMV.
50	H-5589	Paper; .1 mf, ± 20%, 400 V.
51	H-6619-4	Ceramic; 10 K mmf, GMV.
52	H-5589	Paper; .1 mf, ± 20%, 400 V.

Model 140 Standard Deviation Meter

Symbol	Part No.	Description
C53		
54	H-5589	Paper; .1 mf, ± 20%, 400 V.
55	H-6690-1	Paper; 2 mf, ± 20%, 400 V.
56	H-6682-5	Mica; 2 K mmf, ± 1%.
57	H-6682-5	Mica; 2 K mmf, ± 1%.
58	H-6682-6	Mica; 1 K mmf, ± 1%.
59	H-6618	Paper; .25 mf, ± 20%, 400 V.
60	H-6306	Ceramic; 20 K mmf, GMV.
61	H-6306	" " " "
62		
63	H-6619-4	Ceramic; 10 K mmf, GMV.
64	H-6618	Paper; .25 mf, ± 20%, 400 V.
65	H-6689-1	Mica; 10 K mmf, ± 10%.
66	H-6689-1	" " " "
67	H-5589	Paper; .1 mf, ± 20%, 400 V.
68	H-6682-6	Mica; 1 K mmf, ± 1%.
69		" " " "
70		
71		
72		
73		
74		
75		
CR1	H-6677	Rectifier.
2	"	"
3	"	"
4	"	"

Model 140 Standard Deviation Meter

Symbol	Part No.	Description
CR5	H-6677	Rectifier
6	"	"
7	H-6678	"
8	H-6606	Semicap
9		Diode; IN273
10		" IN82
11		" IN82
12		" IN627
13		" IN627
14		" IN627
15		" IN627
16		" IN627
17		" IN627
18		" IN627
19		" IN627
20		" IN1081
21		" IN627
22		" IN627
E1	H-5016	Lamp; #44
2		Tube; Glow OB2.
3		5651
4		OA2
5		5651
F1	H-5018-9	Fuse, cartridge, 1A Slow Blowing
2	H-5109-2	" " 1/4A AGC.

Model 140 Standard Deviation Meter

Symbol	Part No.	Description
J1		Connector; UG625/u.
2		" "
3	H-5506-2	Jack; Pin.
4	H-4131	Jack; Phone.
5	H-5506-1	Jack; Pin.
L1	H-5744	Coil; 50 uh.
2	H-6961	Coil; Tune Meter
3	H-6960	Coil; AF, 45 mh.
4	H-6960	" " "
5	H-6960	" " "
6		
7		
M1	H-6964	Meter; 0-200 ua.
P1	H-6673	Connector; Male, Power.
Q1		Transistor; 2N3584.
R1	H-6364	Fixed; wirewound, 400 ohms, ± 5%, 20 W.
2	H-6364	" " " " " "
3		
4	H-3728-332	Fixed, Comp.; 3.3 K ohms, ± 10%, 1/2 W.
5	H-3731-243	" " 24 K " ± 5%, 1 W.
6		
7		
8		
9	H-3727-115	Fixed, Comp.; 1.1 M ohms, ± 5%, 1/2 W.
10	H-3727-305	Fixed, Comp.; 3 M ohms, ± 5%, 1/2 W.
11	H-3728-474	Fixed, Comp.; 470 K ohms, ± 10%, 1/2 W.
12	H-6691-2	Fixed; 40 K ohms, ± 5%, 10 W.
13	H-6687-3	Variable, Comp.; 10 K ohms, ± 10%, 2 W.
14	H-6691-1	Fixed; 20 K ohms, ± 5%, 7 W.

Model 140 Standard Deviation Meter

Symbol	Part No.	Description
R15	H-3728-474	Fixed, Comp.; 470 K ohms, ± 10%, 1/2 W.
16	"	" " " " " "
17	"	" " " " " "
18	"	" " " " " "
19	"	" " " " " "
20	"	" " " " " "
21	H-3731-270	Fixed, Comp.; 27 ohms, ±10%, 1 W.
22	H-6684-2	" W.W. 1 K ohms, ±5%, 1 W.
23	H-6684-1	" " 2 K " ± 5%, 10 W.
24	H-3728-473	Fixed, Comp.; 47 K ohms, ±10%, 1/2 W.
25	H-3728-154	" " 150 K ohms, ±10%, 1/2 W.
26	H-3728-101	" " 100 " ±10%, 1/2 W.
27	H-3728-154	" " 150 K " ±10%, 1/2 W.
28	H-6687-8	Variable, Two Ganged Sections 50 K & 250 K ohms, 10%,
29	H-3728-332	Fixed, Comp.; 3.3 K ohms, ±10%, 1/2 W.
30	H-3728-472	" " 4.7 K " " 1 W.
31	H-3728-471	" " 470 " ±5%, 1/2 W.
32	H-6686-9	Fixed, Film; 63 ohms, ±1%, 1/2 W.
33	H-6686-14	" " 248 " " "
34	H-6686-9	" " 63 " " "
35	H-3728-103	Fixed, Comp.; 10 K ohms, ±10%, 1/2 W.
36	H-3728-473	" " 47 K " " "
37	H-3728-104	" " 100 K " " "
38	H-3728-331	" " 330 " " "
39	H-3728-104	" " 100 K " " "
40	H-3728-331	" " 330 " " "

Model 140 Standard Deviation Meter

Symbol	Part No.	Description
R41	H-6601	Variable; 20 ohms, 5 W.
42	H-3728-105	Variable Comp.; 1 M ohms, ± 10%, 1/2 W.
43	H-3728-222	Fixed, Comp.; 2.2 K ohms, ±10%, 1/2 W.
44	H-3728-103	" " 10 K " " "
45	H-3728-222	" " 2.2 K " " "
46	H-3728-103	" " 10 K " " "
47	H-3728-104	" " 100 K " " "
48	H-3728-222	" " 2.2 K " " "
49	H-3728-103	" " 10 K " " "
50	H-6687-5	Variable, 25 K ohms, 2 W,
51	H-3727-432	Fixed, Comp.; 4.3 K ohms, ± 5%, 1/2 W.
52	H-3728-561	" " 560 " 10%, "
53	H-3728-222	" " 2.2 K " " "
54	H-3728-103	" " 10 K " " "
55	H-3728-561	" " 560 " " "
56	H-3728-471	" " 470 " " "
57	H-3728-103	" " 10 K " " "
58	H-3728-223	" " 22 K " " "
59	H-3728-104	" " 100 K " " "
60	H-3728-104	" " 100 K " " "
61	H-3728-222	" " 2.2 K " " "
62	H-3728-103	" " 10 K " " "
63	H-3728-104	" " 100 K " " "
64	H-3728-222	" " 2.2 K " " "
65	H-3728-332	" " 3.3 K " " "
66	H-3728-183	" " 18 K " " "
67	H-3728-103	" " 10 K " " "

Model 140 Standard Deviation Meter

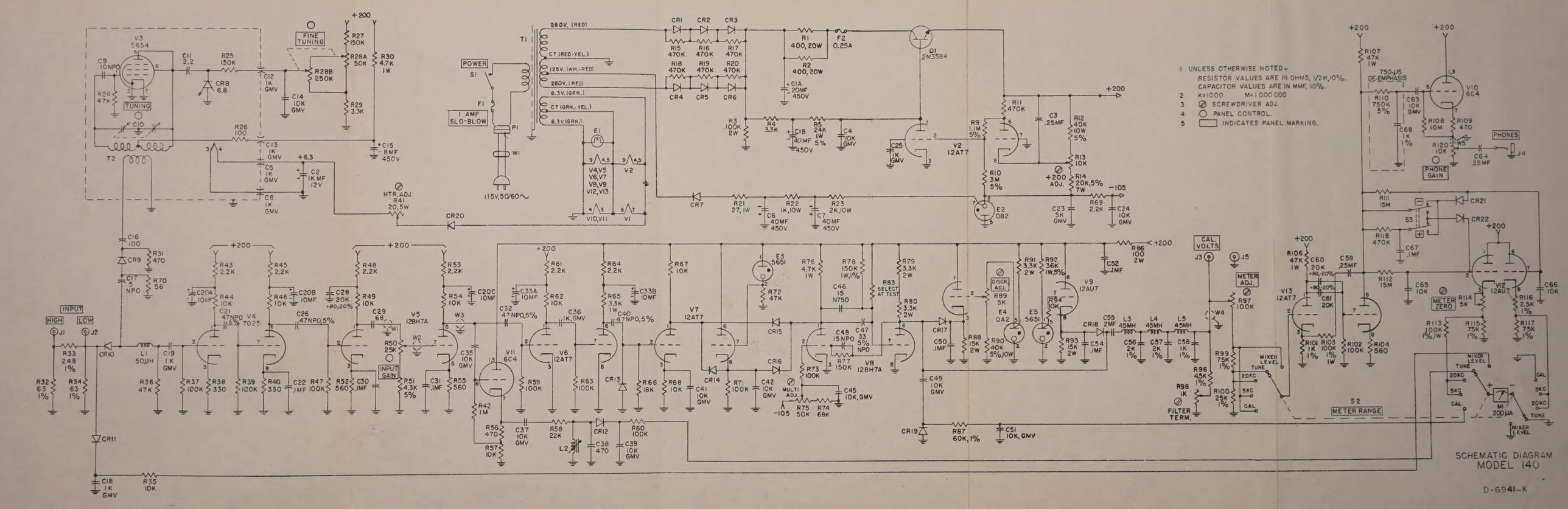
Symbol	Part No.	Description
R68	H-3728-103	Fixed, Comp.; 10 K ohms, ±10%, 1/2 W.
69	H-3728-222	" " 2.2 K " " "
70	H-3728-560	" " 56 " " "
71	H-3728-104	" " 100 K " " "
72	H-3728-473	" " 47 K " " "
73	H-3728-104	" " 100 K " " "
74	H-3728-683	" " 68 K " " "
75	H-6687-6	Variable; 50 K, ±10%, 2 W,
76	H-3731-472	Fixed, Comp.; 4.7 K ohms, ±10%, 1 W.
77	H-3728-154	" " 150 K " ±10%, 1/2 W.
78	H-6969-11	Fixed; 150 K ohms, ±1%, 1 W,
79	H-3734-332	Fixed, Comp.; 3.3 K ohms, ±10%, 2 W.
80	H-3734-332	" " 3.3 K " " "
81		
82		
83		Value selected at test.
84		
85		
86	H-3734-101	Fixed, Comp.; 100 ohms, ± 10%, 2 W.
87	H-6969-6	Fixed; 60 K ohms, ±1%, 1/2 W, W.W.
88	H-3734-153	Fixed, Comp.; 15 K ohms, ±10%, 2 W.
89	H-6687-2	Variable; 5 K ohms, ±10%, 2 W,
90	H-6691-2	Fixed; 40 K ohms, ±1%, 2 W,
91	H-3734-332	Fixed, Comp.; 3.3 K ohms, ±10%, 2 W.
92	H-3730-363	" " 36 K " ±5%, 1 W.
93	H-3734-153	" " 15 K " ±10%, 2 W.
94	H-3728-103	" " 10 K " " 1/2 W.

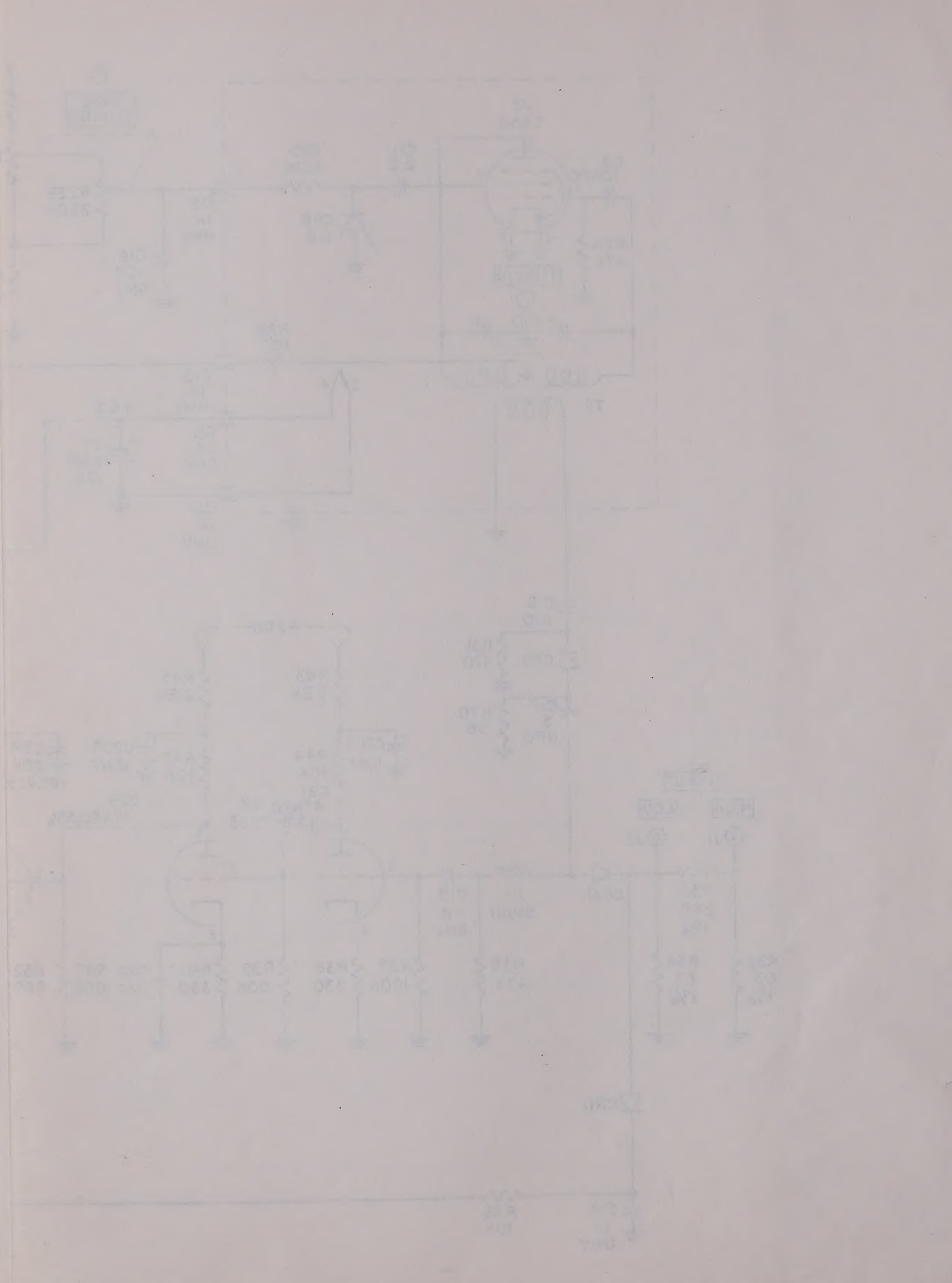
Model 140 Standard Deviation Meter

Symbol	Part No.	Description
R95		
96	H-6969-3	Fixed; 4.5 K ohms, ± 1%, 1/2 W, W.W.
97	H-6687-7	Variable; 100 K ohms, ± 10%, 2 W.
98	H-6687-1	" 1 K " " "
99	H-6969-7	Fixed; 75 K ohms, ± 1%, 1/2 W, W.W.
100	H-6969-4	" 25 K " " " "
101	H-6969-1	" 1 K " " " "
102	H-3728-104	Fixed, Comp.; 100 K ohms, 10%, 1/2 W.
103	H-6969-8	Fixed; 100 K ohms, ± 1%, 1 W, W.W.
104	H-3728-561	Fixed, Comp.; 560 ohms, ± 10%, 1/2 W.
105		
106	H-3731-473	Fixed, Comp.; 47 K ohms, ± 10%, 1 W.
107	H-3731-473	" " 47 K " " "
108	H-3728-106	" " 10 M " " 1/2 W.
109	H-3728-471	" " 470 " " "
110	H-3727-754	" " 750 K " ± 5% "
111	H-3728-156	" " 15 M " ± 10% "
112	H-3728-156	" " 15 M " " "
113	H-6969-8	Fixed; 100 K ohms, ± 1%, 1 W, W.W.
114	H-6687-2	Variable; 5 K ohms, ± 10%, 2 W. Lin. 1/8" slotted shaft.
115	H-6969-7	Fixed; 75 K ohms, ± 1%, 1/2 W, W.W.
116	H-6969-2	Fixed; 2.5 K " " " " "
117	H-6969-7	Fixed; 75 K " " " " "
118	H-3728-474	Fixed, Comp.; 470 K ohms, ± 10%, 1/2 W.
119		
120	H-6687-4	Variable; 10 K ohms, ± 10%, 2 W. Lin. 1/2" shaft.
121		

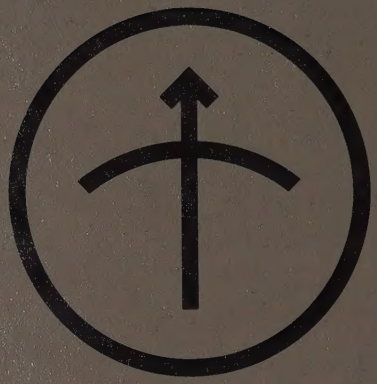
Model 140 Standard Deviation Meter

Symbol	Part No.	Description
S1	H-6653	Switch, Toggle, SPST.
2	H-6963	" Rotary, 4 Pole, 5 Position.
3	H-6639	" Toggle, DPDT
T1	H-6959	Trans., Power
2	H-6988	" RF, Osc. (Less output loop)
V1		
2		" " 12AT7.
3		" " 5654/6AK5W.
4		" " 7025.
5		" " 12BH7A.
6		" " 12AT7.
7		" " 12AT7.
8		" " 12BH7A.
9		" " 12AU7.
10		" " 6C4.
11		" " 6C4.
12		" " 12AU7.
13		" " 12AT7.
W1	H-7402	Cable, Power.


+200
FINE TUNING
R27 150K
R28A 50K
R28B 250K
R29 3.3K
R30 4.7K 1W
V3 5654
C9 10NPO
C11 2.2
R25 150K
CR8 6.8
C12 1K GMV
C14 10K GMV
R24 47K
TUNING
C10
R26 100
C13 1K GMV
C15 .8MF 450V
T2
+6.3
C5 1K GMV
C2 1K MF 12V
C8 1K GMV
HTR. ADJ. R41 20,5W
CR20
T1
260V. (RED)
CT (RED-YEL.)
125V. (WH.-RED)
260V. (RED)
6.3V. (GRN.)
CT (GRN.-YEL.)
6.3V. (GRN.)
POWER
S1
F1
1 AMP SLO-BLOW
P1
W1
115V, 50/60~
E1
V4,V5 V6,V7 V8,V9 V12,V13
V2
V10,V11
V1
CR1 CR2 CR3
R15 470K
R16 470K
R17 470K
R18 470K
R19 470K
R20 470K
CR4 CR5 CR6
R1 400, 20W
R2 400, 20W
F2 0.25A
C1A 20MF 450V
Q1 2N3584
R3 100K 2W
R4 3.3K
C1B 40MF 450V
R5 24K 1W 5%
C4 10K GMV
C25 1K GMV
V2 12AT7
R9 1.1M 5%
R11 470K
C3 .25MF
R12 40K 10W 5%
R13 10K
R10 3M 5%
+200 ADJ.
R14 20K,5% 7W
-105
R69 2.2K
C23 5K GMV
C24 10K GMV
E2 OB2
CR7
R21 27, 1W
C6 40MF 450V
R22 1K,10W
C7 40MF 450V
R23 2K,10W
1 UNLESS OTHERWISE NOTED- RESISTOR VALUES ARE IN OHMS, 1/2W, 10%. CAPACITOR VALUES ARE IN MMF, 10%.
2 K=1000 M=1 000 000
3 SCREWDRIVER ADJ.
4 PANEL CONTROL.
5 INDICATES PANEL MARKING.
+200
R107 47K 1W
750-µS DE-EMPHASIS
R110 750K 5%
C68 1K 1%
V10 6C4
C63 10K GMV
R108 10M
R109 470
PHONES
J4
R120 10K
W5
C64 .25MF
PHONE GAIN
R111 15M
CR21
CR22
S3
R118 470K
C67 .1MF
+200
R106 47K 1W
C60 20K +80,-20%
C59 .25MF
V13 12AT7
C61 20K +80,-20%
R112 15M
C65 10K
METER ZERO
R114 5K
V12 12AU7
C66 10K
R116 2.5K 1%
R101 1K 1%
R103 100K 1% 1W
R102 100K
R104 560
R113 100K 1%,1W
R115 75K 1%
R117 75K 1%
MIXER LEVEL TUNE
20KC
5KC
CAL
MI 200µA
S2 METER RANGE
INPUT
HIGH
LOW
J1
J2
CR10
L1 50µH
C19 1K GMV
R33 248 1%
R32 63 1%
R34 63 1%
R36 47K
R37 100K
R38 330
R39 100K
R40 330
C22 .1MF
R47 100K
R52 560
C30 .1MF
R51 4.3K 5%
R55 560
C31 .1MF
CR11
C18 1K GMV
R35 10K
R43 2.2K
R45 2.2K
C20A 10MF
C20B 10MF
R44 10K
R46 10K
C21 47NPO +5% V4 7025
C26 47NPO,5%
C28 20K +80,-20%
C29 68
W1
W2
R48 2.2K
R49 10K
R50 25K
INPUT GAIN
R53 2.2K
R54 10K
C20C 10MF
W3
V5 12BH7A
C35 10K GMV
R42 1M
R56 470
R57 10K
C37 10K GMV
R58 22K
L2
CR12
C38 470
C39 10K GMV
R60 100K
R61 2.2K
C33A 10MF
R62 10K
C32 47NPO,5%
C36 1K, GMV
V6 12AT7
R63 100K
CR13
R64 2.2K
R65 3.3K 1W
C40 47NPO,5%
C33B 10MF
R66 18K
R68 10K
C41 10K GMV
R67 10K
V7 12AT7
CR14
R71 100K
C42 10K GMV
E3 5651
R72 47K
CR15
C46 15 N750
C48 15NPO
R77 150K
CR16
MULTI ADJ.
R73 100K
R75 50K
R74 68K
-105
C45 10K, GMV
R76 4.7K 1W
R78 150K 1W,1%
R83 SELECT AT TEST
C47 33 5% NPO
R79 3.3K 2W
R80 3.3K 2W
V8 12BH7A
CR17
R88 15K 2W
C50 .1MF
C49 10K GMV
CR19
R87 60K,1%
C51 10K, GMV
DISCR. ADJ.
R89 5K
E4 0A2
R90 40K 5%,10W
R91 3.3K 2W
R92 36K 1W,5%
E5 5651
R94 10K
V9 12AU7
R93 15K 2W
C54 .1MF
CR18
C55 2MF
L3 45MH
L4 45MH
L5 45MH
C56 2K 1%
C57 2K 1%
C58 1K 1%
R96 45K 1%
R98 1K
FILTER TERM.
R100 25K 1%
R99 75K 1%
W4
R97 100K
METER ADJ.
CAL. VOLTS
J3
J5
R86 100 2W
C52 .1MF
R85 1K 2W
C62 .1MF
R84 1K 2W
C53 .1MF
R82 1K 2W
C44 .1MF
R81 1K 2W
C43 .1MF
R70 56
C16 100
R31 470
C17 5 NPO
R31 2.2K
C9 10NPO
R24 47K
C10
R26 100
C13 1K GMV
C15 .8MF 450V
T2
+6.3
C5 1K GMV
C2 1K MF 12V
C8 1K GMV
HTR. ADJ. R41 20,5W
CR20
T1
260V. (RED)
CT (RED-YEL.)
125V. (WH.-RED)
260V. (RED)
6.3V. (GRN.)
CT (GRN.-YEL.)
6.3V. (GRN.)
POWER
S1
F1
1 AMP SLO-BLOW
P1
W1
115V, 50/60~
E1
V4,V5 V6,V7 V8,V9 V12,V13
V2
V10,V11
V1
CR1 CR2 CR3
R15 470K
R16 470K
R17 470K
R18 470K
R19 470K
R20 470K
CR4 CR5 CR6
R1 400, 20W
R2 400, 20W
F2 0.25A
C1A 20MF 450V
Q1 2N3584
R3 100K 2W
R4 3.3K
C1B 40MF 450V
R5 24K 1W 5%
C4 10K GMV
C25 1K GMV
V2 12AT7
R9 1.1M 5%
R11 470K
C3 .25MF
R12 40K 10W 5%
R13 10K
R10 3M 5%
+200 ADJ.
R14 20K,5% 7W
-105
R69 2.2K
C23 5K GMV
C24 10K GMV
E2 OB2
CR7
R21 27, 1W
C6 40MF 450V
R22 1K,10W
C7 40MF 450V
R23 2K,10W
SCHEMATIC DIAGRAM
MODEL 140
D-6941-K



MEASUREMENTS



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